Green Energy – Guild Molecular Gate Technology

Digester Gas Treatment for Energy Production /

Pipeline Gas Production from WWTP Digester Gas

The Ohio Water Environment Association
2009 BioSolids Systems Workshop

December 10, 2009

Guild Associates, Inc

Guild Products to the Natural Gas Industry

- Molecular Gate for CO2 Removal
- Compressors
- Molecular Gate for N2 Rejection
- TSA dehydration
  - Water removal
- Sorbead “Quick-Cycle” dew point control
  - Water and heavy hydrocarbon removal systems
- NGL Removal for CARB standards
- CO2 removal for LNG / Peakshaver plants
- Membrane units
- Helium purifiers
- Chiller Packages

Spec Plant Installed

Large unit Installed

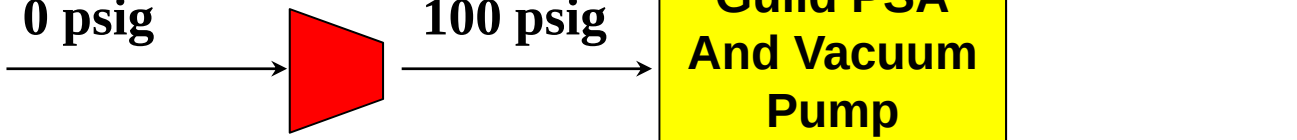
Guild Projects

Unit	Location	SCFM	Status	Separation	Start-up
1	Ohio	140	Relocated	N2	Aug. 2002
2	California	700	Operating	CO2	May 2002
3	Texas	700	Operating	N2	Aug 2003
4	California	7000	Operating	CO2	Dec 2003
5	Kentucky	1050	Operating	N2	May 2004
6	Illinois	1750	Operating	N2 & CO2	May 2004
7	Indiana	2100	Operating	N2	Dec 2004
8	Virginia	1400	Operating	N2 and CO2	Feb 2005
9	Kentucky	700	Operating	N2	Jan. 2006
10	SPEC #1 - OH	300	Operating	N2	Dec. 2005
11	Virginia	1050	Operating	N2 & CO2	Sept. 2005
12	SPEC #2 - WV	550	Operating	N2	Dec. 2005
13	West Virginia	1050	Operating	N2	April 2005

Guild Projects (Digesters in Blue / Landfill in Yellow)

Unit	Location	Feed SCFM	Status	Separation	Start-up
14	SPEC #3 - ID	350	Operating	CO2	May 2006
15	Virginia	7000	Operating	N2 & CO2	Jan. 2007
16	West Virginia	1050	Operating	N2 & CO2	Jan. 2007
17	SPEC #4 - WV	1050	Ready to Ship	CO2	TBD
18	UK	850	Operating	N2 & CO2	May 2008
19	West Virginia	700	Ready to Ship	CO2	TBD
20	Pennsylvania	1400	Operating	N2 & CO2	May 2008
21	SPEC #5 - ID.	350	Operating	CO2	May 2008
22	SPEC #6 - IL.	350	Operating	N2	May 2007
23	California	1000	Operating	CO2	May 2008
24	Washington	5600	Operating	N2 & CO2	March 2009
25	Tennessee	850	Operating	N2&CO2	December 2008
26	West Virginia	600	Ready to Ship	N2	TBD
27	Canada	850	Operating	CO2	June 2009
28	California	2300	Operating	N2 & CO2	July 2009
29	California	850	On Site for Start-up	N2	August 2009
30	Pennsylvania	5000	Operating	N2 & CO2	June 2009
31	Texas	1250	Design	CO2	January 2010
	Ohio	< 100 SCFM	Operating	CO2	March 2009

Digester Gas Flow Balance – Single Step Processing



FEED

CH4

CO2

H2S

Siloxanes

H2O

PRODUCT

Pressure as needed

CO2 = 1 to 2%

H2S = < 4 ppm

Siloxanes < 20 ppb

H2O = 7 lb/MM SCF

TAIL GAS

3 psig

CO2, H2S, H2O

Lost Hydrocarbons

Process Steps – Digester Gas

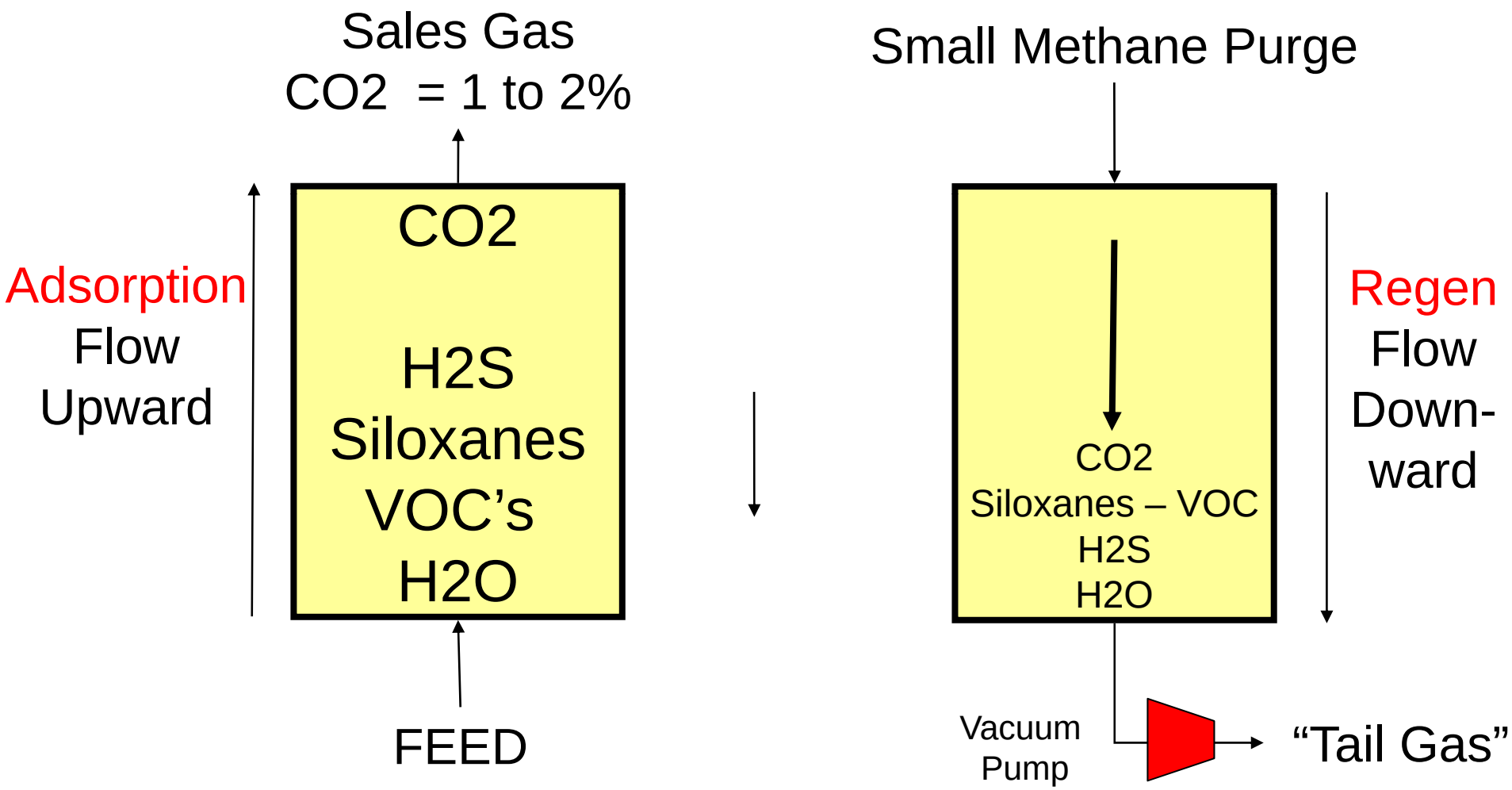
Product

Guild PSA and Vacuum Pump

Feed Compression

Tail Gas To Flare or Boilers

Digester Gas Upgrading Process Steps



Typical Digester Material Balance (Methane Recovery = 90%)

	Feed	Sales Gas	Tail Gas
Flow	**100**	**55**	**45**
Pressure, psig	**100**	**90**	**3**
Temperature, F	**100**	**100**	**150**
Composition, Mol %			
C1	**60.00**	**99.00**	**13.20**
CO2	**39.60**	**1.00**	**85.92**
H2S	**0.40**	**< 4 ppm**	**0.88**
Siloxanes	**~ 10 ppm**	**< 20 ppb**	**By Difference**
H2O	**Saturated**	**7 lb/MM SCF**	**Wet**
HHV BTU/FT3	**609**	**1000**	**139**

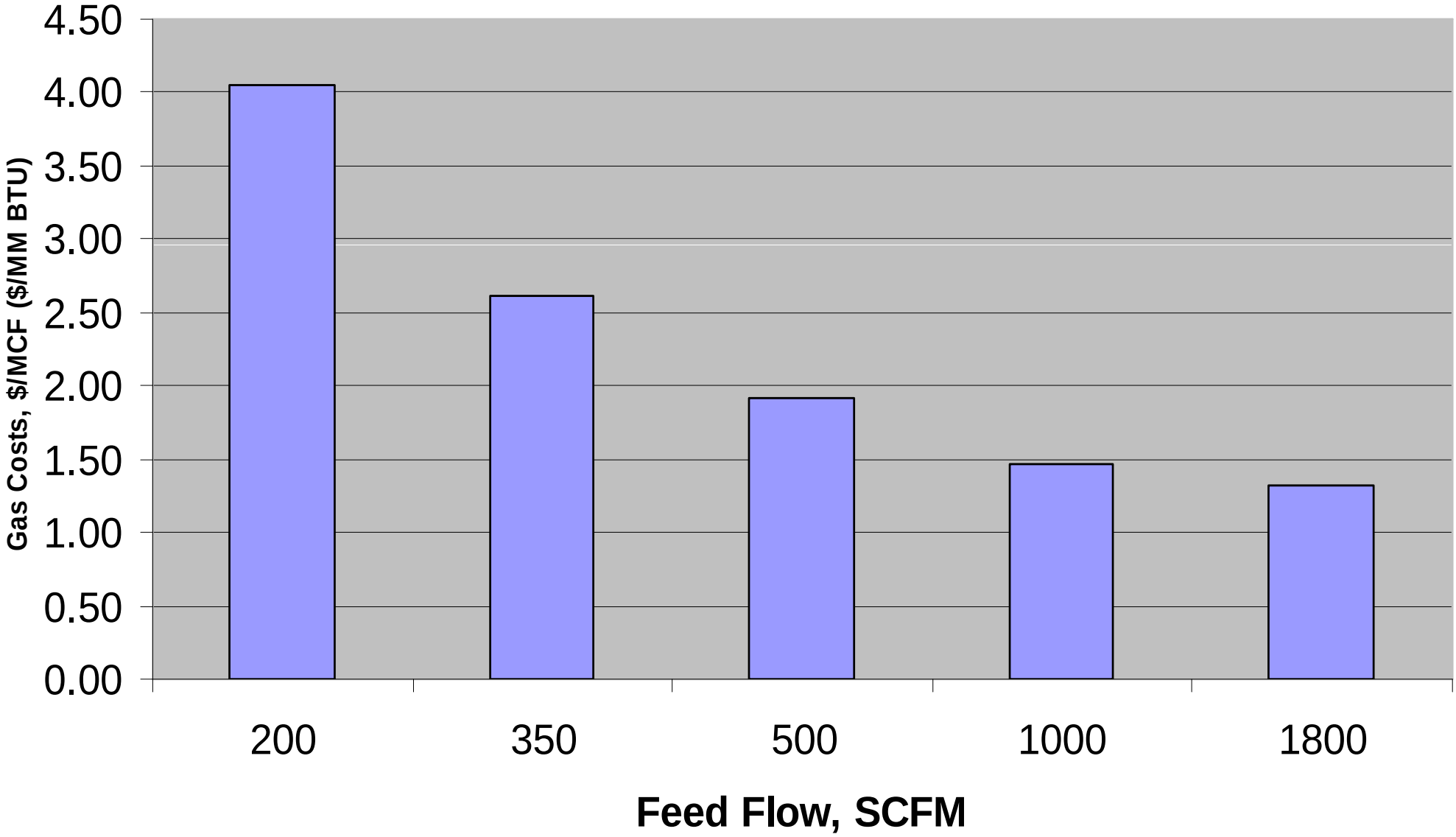
Pipeline Acceptance

- Intrepid Technology and Resources, ID (Two units)
  - Extensive testing of product stream purity
  - Quality accepted by Intermountain Gas Company
  - Sales also accepted as CNG meeting DOT regulations
  - Removes 40% CO_2 to <2%, Dehydrates, Removes 4000 ppm H_2S to < 4 ppm.
- BioEnergy Solutions, CA (Vintage Dairy)
  - Sales to PG&E pipeline
  - Removes 30 to 40% CO_2 to <1%, Dehydrates, A few hundred ppm H_2S removed to < 4 ppm
- Newark WWTP (Ohio)
  - Producing pipeline quality gas

Project Optimization

- H2S
  - May or may not require treatment.
  - Can treat on tail gas stream (preferred) or feed stream
  - Options:
    - No Treatment, Digester Additives, Biological Treatment, Sulfatreat / Iron Sponge, Liquid Redox
- Tail Gas Disposal
  - Enclosed thermal oxidizer if design for high methane recovery
  - Digester heating possible with combustion of tail gas.
  - Recovery of heat from compression or flare. Generally expensive and limited to larger flows
- Required Pipeline Pressure
  - High pressure requires additional compressor

Product Based Processing Costs, $/MCF
Includes = Feed compression, PSA, Flare, Pipeline Tap,
Installation, Power (5 cents/kW), Maintenance, Man-Power
10 year project at 8% Loan



Tidelands
CO_2 Removal System

1 MM SCFD

38% CO_2
Removed to <2%

Start-up May 2002


Large Biogas
Feed
Compressor


Small
Feed
Compressor
FUEL A PANEL
DANGER
120 VOLTS
LIFT
LIFT
NO LIFT


Spec Plant
in Transit

Spec Plant Installed


Mark


LIFT
LIFT
LIFT

Large unit Installed

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